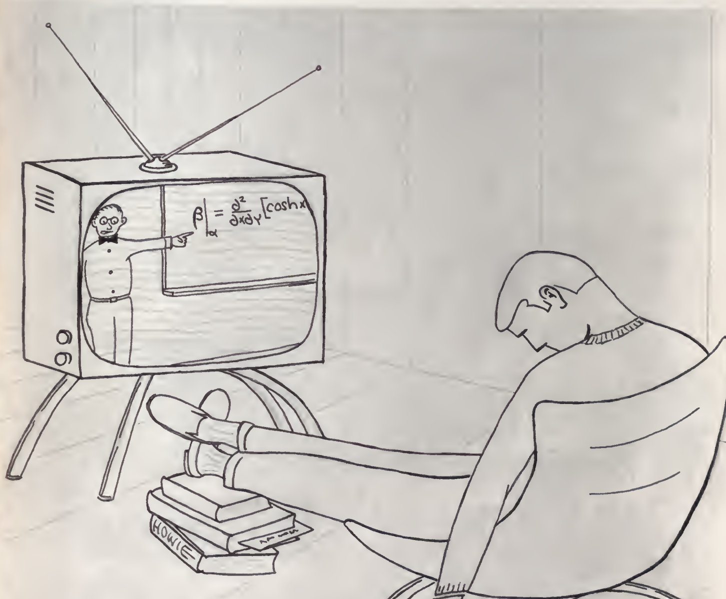
the Mechelecív

VOL. 18 MARCH, 1960 NO. 4

THE GEORGE WASHINGTON UNIVERSITY SCHOOL OF ENGINEERING



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VOL. 18 MARCH, 1960 NO. 4

ARTICLES

DEPARTMENTS

FRONTISPIECE:

The picture on this month's frontispiece was taken by George Lea, ME-60, and shows part of the array of books he has collected in the years he has been at George Washington University.

ON THE COVER:

A student availing himself of the advantages of educational television. See Ray Morales' article on page 5.

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Editorial Page

A Matter of Principle

We have seen some adverse comments about the loyalty oath and the affidavit connected with the national defense loans. Apparently all of the criticism centers around the affidavit which lists the organizations considered subversive by the Justice Department, and requires anyone who is a member of any one of them to so state. We understand that the critics are upset because they feel that they are being singled out as suspects of subversion. The farmers who receive subsidies and those receiving Social Security benefits don't have to sign them, they complain. This is true. But recipients of the national defense loans are receiving money from the Defense Department for advancing their education in lines which will help the national security. Surely no one can object to the Defense Department's requirement that all recipients of the loans be loyal Americans. Anyone who falsely claims that he has not been a member of the subversive groups named in the affidavit can be prosecuted for having falsely signed the affidavit. That there are also other laws under which they can be prosecuted merely complements the affidavit, and does not eliminate its usefulness. Certainly any Communist would sign the paper without second thought. Why shouldn't any loyal citizen?

MONTHLY QUIZ

Where's the computer?
Answer on page 22

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Educational Television (ETV) and the College Student

by RAYMOND P. MORALES, E.E. '62

College educational methods differ considerably from methods employed during earlier phases of education in that the student's initiative plays a much more important role. This difference, as considered by ETV advocates, is favorable in many respects, since teaching by television is quite similar to teaching in the college classroom, the primary differences being:

a. The instructor does not have face to face contact with the student at the time of the lecture.
b. The classes are larger in a class taught by television for economical reasons.
c. Methods for the evaluation of a telecourse are not yet as complete as evaluation methods for conventional courses.
d. The costs for the two methods are not equal.

An extensive experiment performed at Pennsylvania State University shows how some of these differences, and several other problems, might be resolved. At the start of the experiment, most of the conditions were kept as similar to ordinary classroom conditions as was feasibly possible; instructors taught before a class with the addition of the television camera in the room, and students sat in other rooms with television sets before them. This method introduced the student to the television receiver, and the instructor to the television camera. Later, fewer students sat before the instructor, and eventually the instructors decided that it would be best if they taught directly into the camera, thereby letting the students have direct eye contact with the instructor's image on the screen. Several class sizes were tried with varying conditions; small television and control classes each with an instructor present, and the television class again without the instructor, large classes with very much the same experimental conditions, television classes followed by discussions and again without discussion groups; as a result, it was found that there was no significant difference between the two teaching methods. Tests, given to measure the attitudes and achievements in the control and television classes, taught by the same instructors, also showed no significant difference. It should be noted that there are tests in some courses that, when given to both television and control classes, will yield the same results, but cannot be considered as showing a fair comparison. An example that has been cited is that of Robert Frost reading his own poetry to a television class (a very plausible expectation), and a conventional class reading the same poetry without the benefit of his presence. The television class obviously gains an experience that the others do not, and there is no way of measuring this. In classes of this type, a "no significant difference" report is most assuredly favorable to the ETV student if the experience gained is considered. The tests given at Penn State also failed to show the difference between a student learning from an outstanding instructor via television, and a student learning from an average instructor under ordinary classroom conditions. A student reaction, however, did indicate a difference in the teaching methods; when exposed to both types of teaching, they preferred the television method, and performed equally well. One interpretation of this reaction would be that the student found ETV easier. In any event, ETV proved itself better in that it satisfied a student preference, thereby increasing his motivation toward the course.

The professors at Penn State have had varied reactions toward educational television. Many feel quite strongly against it, but it is felt that if a method of testing were devised to show the true difference between the two types of teaching, these adverse feelings would diminish. Other professors favor ETV with equal fervor, but this may also be due to impetuous reactions as they cannot have weighed, honestly, all the evidence which might exist against the televised education. The largest majority of professors, however, is indifferent towards ETV, and many of these have never observed a televised class.

The cost factors of the experiment at Penn State were weighed quite carefully. It was found that televised courses were feasible if certain conditions were met:

1. The use of certain moderate or low cost equipment was as it proved to be quite adequate.
2. University personnel, who are usually available, should be used for the operation and maintenance of equipment.

3. Classes should be kept above a break even point of two hundred students.

This last point requires some explanation. The 200 figure was decided upon with the contention that it would be cheaper to instruct smaller classes by conventional methods, in groups of forty-five. The size of the smaller classes actually depends on the course being taught. If the subject matter requires that the class size be less than the estimated forty-five, it would obviously reduce the break even point by a proportional amount, and the inverse is, of course, also true. The savings realized in teaching an appropriately large class through television would be quite substantial.

Other experimentation in the use of television at the college level yielded many more favorable results. One woman completed all her required course work by means of television and was graduated from the Chicago City Junior College. The fact that she was the mother of ten children made this achievement even more significant. In 1957, this same college had 1,511 students registered for a total of 8,476 credit hours, and an additional 5,728 registrants for non-credit, VIA TELEVISION. Further adaptations of televised instruction have been shown to be feasible; (a) televising lecture portions of courses, and supplementing them with regular discussion groups, (b) joining several universities in the same area, and using the outstanding instructors from each of them, (c) presenting distinguished visitors to students in various universities operating on the same network, (d) taping some courses and sending them to smaller universities that could not otherwise offer them, (e) teaching students in the home, etc.

The advantages of educational television are becoming more and more evident, and as they do, colleges are joining the ever growing population of ETV advocates. In support of this, one has but to look at examples of college courses that are taught by television; Electric and Magnetic Field Theory, General Chemistry, Graphics, American Literature, Biology, Business English, Humanities, Physical Science, Psychology, History, Russian, Spanish, Theology, Anthropology, Zoology, Mathematics, Air Science, Education, Physiology, Accounting, Economics, German, Meteorology, Military History, Music Appreciation, Sociology, and Creative Arts. These courses cover a wide area and serve to show that the limitations in educational television for colleges are indeed minimal; but the successful teaching of these courses does not mean that they cannot be improved upon. Taking advantage of the experience gained from teaching these courses, the Communication Arts Group of New York University circulated a questionnaire seeking an insight into the areas that needed investigation to further the effective use of television in instruction. Of two hundred fifty-six questionnaires received from colleges that were using television, only 185 were tabulated as the others did not properly answer the questions asked. Table I shows the responses received.

TABLE I

Areas of Interest or Concern	*Number of Comments*
1. Measurement of effectiveness of televised instruction	110
2. Methods of instruction	67
3. The faculty and televised instruction	72
4. The student and televised instruction	42
5. Possible uses of closed-circuit televised instruction	37
6. Technical aspects of televised instruction	26
7. Open-circuit televised instruction	31
8. Cost analysis of televised instruction	16
9. Miscellaneous comments	18
Total number of comments	419
Total number of respondents	185

* Many respondents provided several comments. Hence number of comments exceeds number of respondents.

It should be mentioned here that the respondents had all worked with educational television as instructors, and were therefore acquainted with at least the basic fundamentals of this type of instruction. With this in mind, several of the comments made about the listed areas may be subjectively viewed. The comments discussed will, for the most part, reflect the desires of the majority of respondents in each particular area.

Those interested in the first area indicated a desire for studies in the relative effectiveness of televised instruction, and of specific techniques of ETV presentations, in addition to a desire for a better means for measuring learning. In the second area, comments most strongly requested that audiovisual instructing techniques be further developed, and that intercommunication between student and instructor be studied to determine both feasibility and advisability. Comments in the third area stated a need for the development of criteria for selecting studio teachers, and also an increased compensation for him since the studio teacher would have a much greater responsibility in both planning the course and presenting it. Of equal significance in this area, was the desire expressed to find a means of improving faculty attitudes toward educational television; considering

(Continued on page 30)

Ex-Marine sergeant Ray Morales was born in New York some years ago. Although he is married and has two children, Ray is very active in school life. At present he is a member of the Engineers' Council, and Theta Tau fraternity. For those people who criticize engineers as knowing nothing else but "slide rules and formulas," we are happy to present Ray whose great enjoyment at leisure time is creative writing.

Low Melting Point Bismuth Alloys

by **JOHN M. GOTO, ME '60**

Besides his many theories and experiments, Sir Isaac Newton compounded a very low melting alloy from bismuth, lead and tin. Because of its low melting temperature, the alloy was regarded as a phenomenon rather than a useful product. Therefore, up until World War II bismuth was used mainly for medicines; however, the Cerro de Pasco Corporation, a mining company of Peru, began mining and processing more bismuth than the medical profession could use. Instead of wasting the metal, the company produced the group of "cerro" [1] alloys, which are similar to "Newton's metal." Because of their unusual properties, the bismuth alloys were quickly put to use by modern industrial manufacturers.

The most significant features of the alloys are their very low melting temperatures and expansion properties. The melting points of some are so low that accurately detailed replicas of the palm of a hand can be made without discomfort by spraying it with a molten bismuth alloy.[2] While most metals and alloys contract upon cooling, some of the "cerro" alloys exhibit a net expansion and others return to their original size.

The percents of composition determine the properties of the alloys; therefore, different alloys are used for different purposes. The most common alloys are Cerrotru, Cerrosafe and Cerrobend. Cerrolow, Cerromatrix, Cerrobase and Cerrocast have the same general properties as the other "cerro" alloys but will not be discussed.

Cerrotru is a eutectic alloy of bismuth and tin with a melting point of 281°F. It expands very slightly during solidification but shrinks almost an equal amount during cooling.

The second alloy, Cerrosafe, is generally composed of bismuth, lead, tin and cadmium. Its melting temperature range is 158-194°F. Cerrosafe exhibits slight shrinkage during solidification and undergoes further shrinkage (approximately 0.0015-in./in.) 15 to 20 minutes after casting. However, approximately 30 minutes after casting the alloy begins to grow. In one hour the total shrinkage is overcome. Expansion continues for 500 hours, but at a decreased rate, with an overall growth of approximately 0.0025-in./in.

The third alloy, Cerrobend, consists of bismuth, lead, tin and cadmium; has a melting temperature of 158°F and behaves in the same manner as Cerrosafe, but its total expansion is approximately 0.0057-in./in. Molten Cerrobend cools and crystallizes slowly into a coarse crystal structure; however, rapid chilling yields a fine grained structure and very ductile alloy.[3] A flat surface can be hammered and is malleable, but if the edges are given a sharp blow, pieces will crack off and fly like splintered glass.[4] Tests made on solid bars having a cross section diameter of 3-in. showed that the allow could be bent slowly to an angle of 180 degrees on a zero radius. The sides were not confined so that flattening occurred at the bend, but there were no signs of metal fracture. These bars were twisted several complete rotations, and as before, they showed no signs of fracture. When struck with a hard blow, however, the bars broke readily.[5] Cerrobend must, therefore, be worked slowly in successive stages. Quick bends or pressures will fracture the metal. Because of these unusual properties, the industrial uses of the "cerro" alloys are many.

Cerrotru is used in special solders, in capping armor-piercing shells where the low melting temperature of Cerrotru prevents detonation of the caps, and in the production of lost-wax patterns where the shape of the mold is accurately patterned because the alloy neither expands nor con-

[1] "Cerro" is a trade name prefix for the bismuth alloys produced by the Cerro de Pasco Corporation.

[2] "Ultra-low Melting Alloys", *Scientific American*, p. 16.

[3] "How to Bend Tubes and Sections", *Iron Age*, p. 52.

[4] Cathcart, "Dies Made From Cerrobend For Limited Production", p. 141.

[5] *Ibid.*

tracts after cooling. Molten Cerrotru is sprayed on selenium to form the barrier layer in selenium rectifiers. Again because it neither expands nor contracts, Cerrotru is used to attach fragile parts, such as glass, in equipment where any change in size of the holding material would fracture the part.

Cerrosafe is used in the proof casting of molds, gun chambers and forging dies. It can be sprayed on wooden patterns to make either positive or negative reproductions which are later electroplated with cooper, nickel, or similar metals.

Cerrobend has a number of industrial uses also. The particular use of the alloy usually depends upon the low melting temperature and the expansion properties of the metal. Because they must have low melting temperatures, fuses for safety plugs, automatic sprinkler heads and cores of electroformed hollow articles are made from Cerrobend.

The expanding properties of cooling Cerrobend enables manufacturers to use the alloy for casting and anchoring. Precision castings with small details can be made because the expanding metal fills all the small crevices in the mold. Smooth, fragile materials to be machined, ground or tested are anchored firmly in expanding metal molds. Stationary parts are anchored in machines by first locating the bushings accurately in relation to their shafts and then securing the assembly in place with the alloy. Overheating of bearings from lack of oil melts the cheap alloy instead of ruining the bushing.

Another important use for Cerrobend is in experimental drop-hammer die and stamping processes. Experimental drop-hammer dies for aircraft or automobile parts can cost as much as the final assembly-line dies. It requires weeks to machine a precision die, experimental or final. After tests are run on the drop-hammer, changes are usually made to eliminate fractures or flaws in the stampings. These changes mean more costly machining and time, or sometimes a completely new design change is necessary. To eliminate as many changes or modifications as possible in any industrial plant, engineers must design their equipment with great care to avoid failure even with experimental dies. Many radical ideas in design are never tried for fear that a costly failure might reflect on the engineer's ability. However, Cerrobend has eliminated much of the risk in experimental dies.

By using Cerrobend, radical design can be tried without fear. The cost of dies is greatly reduced by the short time required to make a die, the ease with which a Cerrobend die can be modified, and the salvage (or reuse) of the die after experimentation.

In order to give Cerrobend the strength and hardness required for drop-hammer operations, the dies are cooled to —320°F in liquid nitrogen. While the alloy resembles lead in softness, cooling in liquid nitrogen raises the Brinell hardness number from 9.2 to 45 and increases the tensile strength from 5990 to 25,000 psi. The die warms rapidly when removed from the bath, but 6 to 10 pressings may be made before the alloy becomes too soft. Any modifications of the die are made when the metal is soft, requiring only basic hand tools.[6]

A highly publicized use for Cerrobend has been in the tube bending process, and it was for this specific purpose that the alloy was first produced. Before the production of the alloy on a commercial basis, industries used tube bending fillers such as resin, pitch, sand, spiral springs, mandrels and lead. After it came onto the market, Cerrobend eliminated the difficulties that these materials presented. Resin and pitch are unsuitable for acute angles; Cerrobend can be bent to very small angles. Sand is hard to pack; Cerrobend is simple to pack. Springs and mandrels can be used only for gentle bends; Cerrobend for any bend. Lead is too hot for light metals; low melting Cerrobend can be used for any metal. Most of the above materials leave particles in the tubing; Cerrobend does not. By using the alloy, bends in copper, brass, duralumin, plain steel, stainless steel, chromium and nickel plated tubing can be made without flaking. Bronze tubing with a 0.0035-in. wall thickness has been bent without rippling. A typical process for tube bending is as follows:

1. A clean ladle containing Cerrobend is covered with water.
2. The metal is melted by boiling the water.
3. The hot water and molten Cerrobend are poured into the tubing (which is corked at one end) until the alloy has displaced the water and completely fills the tubing.
4. The tubing is quickly dipped, corked end first, into a tank of cold water and allowed to cool.
5. The tubing is bent to the desired shape by uniform pressure.
6. After forming, the alloy is melted out of the tubing by a steam bath, boiling water or hot air.[7]

(Continued on page 30)

[6] "Soft Alloys Used To Make Short-run Sheet Metals Dies", p. 83.
[7] *Op. cit. Iron Age.*

John M. Goto, a senior in Mechanical Engineering, was born right here in Washington, D. C., in 1930. After attending high school in this area, John spent two years in the Army, and, in February, 1954, he entered George Washington University. John has a busy life. Besides being married and having a young son, he is a full-time employee of Melpar, Inc., and a member of Sigma Tau, the national honorary engineering fraternity.

CAMPUS NEWS

Engineers' Mixer

Those engineers who attended the between semesters mixer held in Monroe Hall were richly rewarded by an interesting talk given by Dr. Leite of the George Washington University Art Department. Entitled "Art and Technology," Dr. Leite's lecture showed that modern architecture and art, notably cubism, have evolved from the Industrial Revolution and that the development of many forms of art has closely paralleled technological development. Dr. Leite showed slides to emphasize his points and judging from the questions which followed, the subject was one of great interest to the engineering audience.


Wayne Davis and Dick Beard enjoying their favorite pastime.


Listening to Dean Walther giving his opinion on art are Sharon Baechler, Bob Gerber, Tom Miller and Janet Miller.

Frank A. Howard Lecture

An overflow audience met last Wednesday, Feb. 24, to hear Mr. Harold K. Wheeler, president of Wheeler Laboratories, Inc., and alumnus of the George Washington University School of Engineering present the Frank A. Howard lecture at the Lisner Auditorium. Mr. Wheeler's topic was "Communications With Submarines," a field in which he is expert. In his lecture Mr. Wheeler discussed the theory of Very Low Frequency propagation, its application and limitations in the art of communicating with undersea craft. The Navy currently operates two huge VLF transmitting stations: the famous "Jim Creek" station in Washington and one at Annapolis, Maryland. A third station is now under construction in Maine and when completed will be the largest of the three with a power input to the antenna of 2 megawatts.

Preceding Mr. Wheeler on the program which was presented by the Alumni Society of the School of Engineering, was the presentation of the Outstanding Senior Student awards to four students representing the four divisions of the engineering school. The awards are based on outstanding scholarship and/or extra-curricular activities. Recipients this year were Lee Potterton, B.S. in Engineering; Lee Snyder, civil engineering; John Roberts, mechanical engineering; and Ray Howland, electrical engineering.

Mr. Wheeler presents Alumni Association Life Membership Certificates to (left to right) Lee Potterton, Lee Snyder, John Roberts and Ray Howland.

Education for Engineers

The following is an excerpt from an address by Dean Martin A. Mason presented at a Joint Meeting of the ASEE, AIEE, ASCE and NSWE in Washington, D. C., October 13, 1959.

It can be reasonably supposed that almost everyone has something ot say about education, and many have by now managed to have their words of wisdom (or otherwise) exposed. In some instances the exposure might better have been left undone, either because there was little merit to what was said, or because the words meant little to those who heard. In far too few instances the problems have been intelligently analyzed and reasonably objective comments and recommendations made. In which category these remarks will fall is a moot question.

In engineering education, as in other education for a profession, the major effort has become concentrated over the years on preparation to earn a living to the extent that it becomes the dominant and almost exclusive purpose of much higher education. Graduate study, once the hallmark of the scholar, now is largely regarded and practiced as a means by which one acquires another degree having a fairly well defined dollar value in salary. Today the distinction between schools for education for a profession and trade schools might be considered to be essentially semantic.

As an engineer as well as an educator I find myself concerned with the need for acceptance of a broader approach in engineering education, and the vital necessity for education to satisfy all its purposes rather than one. In my thinking, one cannot take for granted that capability to understand human beings and their relationships will develop in some mysterious fashion in our young men and women. I ask, where do engineers today find in their education the means for discriminating the merits of our racial and religious positions, or even of our own professional societies' leadership. How are we to make intelligent choices of people to be our leaders, or to exercise acceptable judgment in matters of concern to mankind and ourselves, unless we know the anatomy and the environment of the problems involved, through the accumulated knowledge and perspective available from education. Engineers, as other educated persons, cannot escape participation in our society; they have no alternative to a vigorous interest in the common welfare and the mores and customs of their fellow human beings; therefore they must be educated and not alone trained for a specific technology.

Pursuing this vein, and inquiring how engineers may be prepared for these responsibilities, one is led to the belief that most of the purposes of education probably cannot be served just by offering courses. Whether the humanities and social science content of curricula be 20% or 100%, whether the curriculum be liberal arts or science or engineering, are much less important (perhaps not at all significant) than whether, in the educational process, the student is made conscious of his responsibilities as an educated man and the strength he has to bring to their satisfaction.

How this may be done best is a question deserving our most serious attention. The solution, or solutions, (for there are most likely many), will certainly bear little resemblance to the educational efforts of today. The elaborate course structures and curricula, the often absurd academic rules and regulations, the mass production in our colleges of those ill-prepared or lacking desire to seek the truth, and the attitude that higher education is little more than sophisticated training in skills will, I believe, not be a part of the solutions.

Whatever the solutions may be, engineers have a golden opportunity to restore real meaning to their education. Leadership in education, not long since the preserve of the humanists, has slipped from the sterile minds and quaking hands of the liberal arts. What virility is there, mankind may inquire, in those who ignore in their teachings the impact and influence of science on our daily lives, and offer only platitudes about the finer things of life, while students cry for leadership through the morass of racism, political theism, great issues and little issues. In this vacuum, engineers, producing the large and small miracles society expects and accepts, occupy a position of influence probably never before held by a group of highly skilled artisans. The opportunity is here, the climate is favorable, we need only the will and the capability.

Perhaps what should be sought is a broad base of mutual understanding, a tremendous arena in which the humanist, the engineer, the physical and the social scientists, in an atmosphere of mutual respect, confidence, and interest, may wrestle with problems of the common welfare. But for this

we need those who can restore education, who can turn the sophisticated trade schools of engineering toward the realization of their broader purpose and opportunity. We must lead our students to know and respect the total significance of music as well as the circuitry and hardware that brings it to our consciousness, to recognize that achieving tuned resonance among men is at least as fascinating and much more difficult than the same problem among circuit components.

One may inquire, why must engineers do this, why not others? Is there a similar responsibility of the worst trade school of all, that of the medicine man (commonly known as "Doctor," or in more enlightened groups as physician)? Regardless of the responsibility of others, I believe engineers must undertake the task because they need most of the benefits to be obtained. For, if we are to manage the resources of nature for the welfare of mankind, we must understand both mankind and nature, and we must show a competence and ability in all aspects of our management that will command the attention and respect of mankind.

Which leads me to another aspect of education for engineers, or for that matter, anyone. I deplore the often expressed comment that in a democracy there is no place for an aristocracy of the learned. If there is one present greatest danger to our way of life it must be in the contempt of our society for the intellectual. I agree with President Harry Gideonse of Brooklyn College who states, "The great challenge of 1959 calls for rearrangement of our national priorities with a view to training our best minds on all levels to their full potential. In a ten-year perspective this may be our only chance for national survival in a world in which only a nation which respects trained intelligence will be able to survive."[1]

In my mind democracy must provide equal opportunity for all, but it must not be prostituted to guarantee equal reward. From the first encounter of the young child with knowledge, to the limit of his ability, there must be competitive selection. If educational institutions do not discharge their responsibility here they surely deserve the low state of respect and confidence they may occupy. There is substantial merit in the thought that each man is what he can be, not what he wants to be.

Whether we like it or not, there is in the world an aristocracy of intellect, and for us to deny the existence is to invite disaster. Engineers, perhaps more than others, are acutely conscious of the need to know the truth, and of the strength that comes from knowledge. There is common acceptance by engineers of an intellectual hierarchy based on knowledge and capability, co-existing with a great reluctance to identify one engineer as better than another, or oneself. Yet we engineers do identify one as more competent than another, and accord the one so identified our respect and confidence. There is no compromise here; no talk of social adjustment or democratic principle can change the elemental fact that the one who knows is superior to the one who does not. In education for engineers, I believe we must strive for excellence and reward those having excellence, even at the expense of those less excellent.

At this point I can almost hear your thoughts: these are fancy words and fine idealistic concepts but—who will hire these educated engineers who may not know how to plunge a transit, or wire a class B amplifier?—How will you go about interesting an engineer in civic responsibilities when he wants most to know something more about Klystrons?—Where do you find the time in a student's curriculum to talk about mankind when you can't find time to talk about something important like ionospheric scatter or three-dimensional stress theory?—Well, so what, I am an engineer now, pretty good salary too, and I never had any of this who-struck-John about humanity or responsibilities.

I don't know the answers to these or many other analogous questions. I know only that until we find the answers society is not likely to accord us the place we believe we richly deserve. Are you satisfied that engineers should be sought by newspaper advertisements as one seeks shoe salesmen, mechanics, and other skilled labor? Are you pleased and happy that engineers are considered fair game for trade union organizers, and that we have trade unions of engineers? Are you proud that the 170 odd million non-engineers in the U.S. don't understand you, somewhat fear you, and generally set you apart as different (if not queer)?

If your replies are negative you might find some merit in examining objectively the possible advantages and benefits to be derived from a somewhat broader approach to engineering education than has been in evidence to date. You might be willing to grudgingly concede that some non-technical activities are as important as ionospheric scatter, or plate girder design, or magnetohydrodynamics; and that mankind may be according us the place we have actually earned, in contradiction to the place we want.

As must be apparent by now it is my belief that education for engineers should be radically different than the current practice, in principle, in procedure, and in purpose. I find it difficult to accept the continued strangulation of all purposes of education other than preparation to earn a living, for this course leads only to continued confirmation of engineering as a highly skilled trade or craft. It annoys me, as I suppose it does you, to be considered by my fellow men as one who is different in some odd way, an engineer, not a professional, possibly not a craftsman, but in the vernacular of the teen-ager, a real odd-ball.

Therefore I am concerned about education for engineers, and hope that other engineers are also. For if we are dissatisfied with our place among men, or the esteem in which we are held, it is our responsibility alone to improve them; and education is the base on which improvement may be built. It is in this vein that I have been bold in exposing these ideas for your consideration, or amusement, or annoyance.

[1] Educational Record, October 1959.

In Memoriam

GEORGE C. WEAVER

Professor George C. Weaver, of the Mechanical Engineering Department, died suddenly on his way to work the morning of March 4, 1960. He was born August 6, 1905 in Mill Hall, Pennsylvania, attended Pennsylvania State University, and the United States Naval Academy, receiving a Bachelor of Science degree from the latter while graduating "with distinction" in June, 1926. He went on to earn a Master of Science Degree in Naval Architecture at the Massachusetts Institute of Technology in 1931.

From 1931 to 1949, Professor Weaver worked with ship design and construction, and during this period, he was awarded the Legion of Merit for direction in submarine and landing craft construction methods.

In June, 1956, Rear Admiral G. C. Weaver retired from the Navy with thirty years of service, and accepted a position as Lecturer in Mechanical Engineering at George Washington University. In April, 1957, he became Associate Professor of Mechanical Engineering. He was currently a member of the University Committee on Scholarship, Chairman of the School of Engineering Committee on Scholarship, and Faculty Advisor to the Engineers' Council. In addition, he was devoting some of his spare time to helping Theta Tau fraternity with an Engineer in Training Examination Review.

Professor Weaver was well liked by both faculty and students, and we, who knew him, would like to express our deepest sympathy to his wife Irene, his son Calvin, and his daughter Jeanne. We sincerely regret having lost a truly devoted instructor.

Norman B. Ames

Prof. Norman B. Ames died on Saturday, March 5. His loss was a great one, not only to the University, where he had been a professor since 1920, but to all of the students and alumni of the George Washington University who had known him and loved him. The Deacon, as he preferred to be called, was a man who did everything wholeheartedly. He was head of the Electrical Engineering Department here from 1929 to 1956. He was an active member of the AIEE, serving as president of the local branch for two years. He was Grand Regent (National President) of Theta Tau, a national professional engineering fraternity. He was active in civic affairs, leading the move for reform of the local Montgomery County government, and acting as president of the commission which wrote the present Charter in 1950. He served as an officer in the Air Force in both world wars. He was an elder of his church. And he was advisor of the student branch of the AIEE, and of the school's chapter of Theta Tau, which he helped establish here. Professor Ames held eight degrees, including an LLB from George Washington, an MS in Engineering from MIT, and a Doctorate degree from the Swiss Institute of Technology in Zurich.

On top of this, the Deacon was a full time professor of Electrical Engineering here at George Washington; a member of several faculty committees. He was the friend and counsellor of all who sought him out. Few who ever met him forgot him. A member of many organizations, he was widely known, both within and outside the engineering profession. For many years he virtually was the Electrical Engineering Department at George Washington, and his contacts with people in industry opened the door for more than one graduate of the Engineering School. The Deacon once said that he felt it was his duty as a professor to get to know as many people as possible in industry so that he could get his students jobs more easily.

The Deacon will be hard to replace. His friendliness toward the student has set a precedent among the faculty, giving rise to one of the closest faculty-student relationships in the country. The Deacon was faculty advisor to both the student branch of AIEE and Theta Tau, and was active in both. His advice was invaluable assistance to the leaders of these organizations.

We of *Mecheleciv,* on behalf of the students of the School of Engineering, extend our sympathy to his family.

D. J. Dumin (E.E. '57) earned his degree at Johns Hopkins. An Associate Engineer at IBM, he is doing original work in the design and testing of thin film circuits. Two of his ideas in this field have been filed upon for patents.

What's New?

Edited by: NICK KOPULOS

A new, fully transistorized, general purpose digital electronic computing system which can serve both scientific and business data processing needs has been announced by the Royal Precision Corporation.

The new RPC-4000 computing unit is capable of operating on 9-digit numbers at rates up to 240,000 operations per minute. The overall high computing speed results from: high operating rates; versatile command list (42 in all) including commands which facilitate double precision and floating point operations as well as a special command designed to speed-up input and output operations; an index register that allows high-speed instruction modification; repeat execution feature; high-speed input-output equipment and an 8-word accumulator for block operation.

The magnetic drum memory section is encased in a metal shroud for protection. The drum is tapered and floats on a cushion of air. When the machine is idle, the drum rests safely away from the heads. Air pressure automatically raises the drum to correct operating position when power is turned on. The memory has a storage capacity of 8,008 words (word length is 32 usable bits, accommodating a 9-decimal digit number), average access time to the main storage is 8.5 milliseconds. Memory may be searched for full or partial words at a sustained rate of nearly 200,000 words per minute. Part of memory (136 words) is available through the high speed line or dual access tracks in from 1 to 6 milliseconds.

The RPC-4000 computing unit may be used for handling both business and engineering problems.

The main memory is non-volatile. Switches allow information to be locked in the main memory in increments of 1024 words—so that it cannot be altered by program or operator error. The arithmetic and control section of memory includes three one-word registers, and one "one-or-eight" word register. When used with the repeat execution feature, the "one-or-eight" word register provides for block arithmetic and block transfers without special commands.

Standard input-output equipment for the RPC-4000 is a tape typewriter system complete with typewriter, desk. tape punch-read console and chair, all specially designed as a unit. Basic reader speed is 60 characters per second, basic punch speed is 30 characters per second. A reversible photoelectric reader, which reads punched paper tape at 500 characters per second, and a high-speed punch may be used as accessories for system expansion.

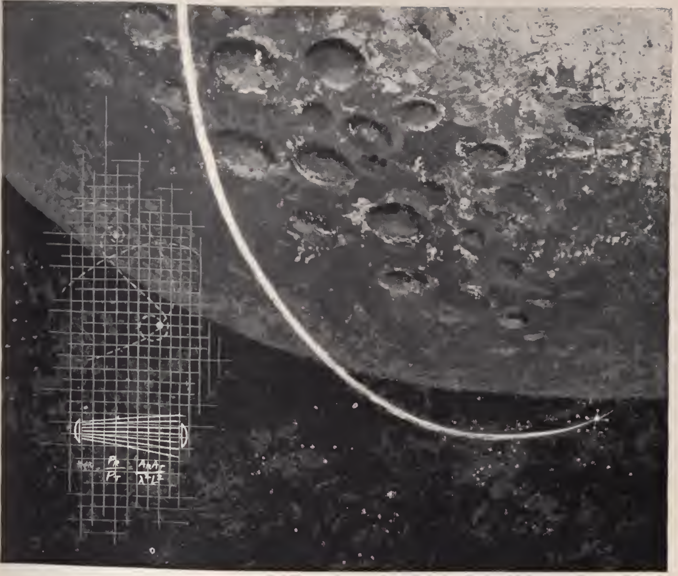
INFRARED SENSING DEVICE AIDS AIR NAVIGATION

A Kodak detector that senses the presence of "invisible light" forms the heart of two new instruments developed for the U. S. Weather Bureau aid to air navigation.

Known as the Kodak Ektron Detector, the infrared sensing device is an essential part of a new cloud-height indicator and of a transmissometer that determines the amount of water vapor in the air.

The cloud-height indicator sends up a rotating beam of infrared radiation. At one angle of rotation, maximum radiation is reflected from the base of the cloud formation and picked up by a detector stationed a known distance from the projector.

The angle between the cloud-scanning beam and the horizon is read from an indicator that shows at what point in the beam's rotation maximum infrared energy was re-



ceived. This angle, plus the distance between projector and detector, enables scientists to calculate cloud base height through triangulation.

The indicator works accurately at cloud heights up to 5,000 feet, the height range of principal interest to pilots during final approach.

The transmissometer works on the principal that varying amounts of water vapor in the air absorb different amounts of infrared radiation.

Again, Weather Bureau scientists use a projector and detector stationed a known distance apart. The projector sends out two different wavelength beams of infrared radiation. One wavelength is partially absorbed by water vapor in the air, while the other passes through it unaffected. An Ekron Detector receives the two wavelengths.

The ratio of the energy transmitted by each beam is a direct index of the quantity of water vapor present in the beam's path.

Weather Bureau researchers have found that this system will measure water vapor at low concentrations and at extremely low temperatures where practically all other field measuring systems fail.

COMPLAINTS

Scientists and engineers in American industry are anything but happy with their lot.

At the root of the problem, an Opinion Research Corporation study disclosed, is a fundamental and unresolved conflict between the scientific mind and the management mind.

The study involved interviews with 622 scientists and engineers and 105 managers in six major companies deeply engaged in scientific research.

Of the scientists and engineers interviewed, 72 per cent complained that management misuses their talents, 71 per cent maintained that their companies force them to overspecialize, and 67 per cent contended that getting ahead in management is more a matter of politics than knowledge.

Although members of one of the most sought-after professional groups in industry, 80 per cent of the scientists and engineers complained they were underpaid when compared with others with similar training and responsibilities.

The study revealed a conflict between management's need to sell its products and make a profit and a basic quest for knowledge by the technical men. While 74 per cent of scientists and engineers interviewed listed sales and profits as primary goals of their companies, fewer than half said they shared these goals.

In addition, 75 per cent complained that corporate pressures did not permit them the freedom "to work in their own way." They cited as obstacles demands for immediate results, schedules, budgetary considerations and pressure to conform to established methods of problem-solving. One of the managers declared that "the place for such a freedom is in academic institutions, not competitive industry."

The study singled out several factors that appear to breed conflict between a company's management and its scientific personnel.

It was found that scientists and engineers have a desire for status and freedom which is difficult to meet in a corporation and is more appropriate to private, professional practice or university life.

It was also shown that technical men often fail to understand techniques and approaches used by management such as managerial decision-making and the nature of risk taking.

In addition, the study disclosed the lack of mutual respect on the part of management and technical groups, with each group tending to evaluate the other's accomplishments and rewards by its own standards.

ORC's research suggested several constructive steps to deal with the management-scientist relationship. These include a need for managers to place greater emphasis on interpreting their everyday decisions to the technical man and a need for more realism during college training and recruiting so that the future scientist or engineer may know what to expect of corporate life.

MICROMINIATURE INCANDESCENT LAMP

The smallest incandescent lamp ever produced on an assembly line has been placed into production by Sylvania Electric Products, Inc. The lamp is small enough to pass through the eye of a darning needle.

The new microminiature lamp developed by Diamond Ordnance Fuze Laboratories has immediate applications in transistorized circuits in missiles, computers and electronic systems.

The body of the lamp is cylindrical with a nominal diameter of .040 inches. Nominal body length is .125 inches. The lamp leads are platinum with a diameter of 0.005 inches. The filament is 0.00025 inch tungsten wire of approximately 30 turns.

The diminutive lamp can be seen in a normally illuminated room. Its light output is in the order of 100 millilumens at 1.5 volts input. The efficiency of the lamp is approximately 1.5 lumens per watt.

Because of its low operating requirements the lamp can be operated directly from the output of a transistor, and it can be used in many display devices for purposes such as computer readout displays and arrays for animation. The lamp's compactness permits its use as an indicator device in push buttons and other visual signals.

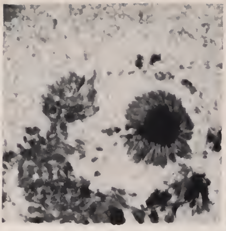
The lamp's tiny filament is less than one-tenth the diameter of a human hair and the light source has low thermal inertia and can be modulated at a rate of more than 100 times per second. This characteristic will allow the lamp to be used in signalling devices incorporating photo tubes and photo diodes that operate with AC amplifiers.

Presumption of Innocence

In a courtroom, it takes twelve men to find out if a woman is innocent. On a country lane in the moonlight, it takes only one.—*The Kansas Twister.*

ANOTHER WAY
RCA SERVES
YOU THROUGH
ELECTRONICS

Going up for "good seeing." Unmanned balloon-observatory starts its ascent to take sunspot photos. "Project Stratoscope" is a continuing program of the Office of Naval Research and the National Science Foundation.



One of the sharpest photos ever taken of sun's surface. It, and hundreds of others taken by stratoscope, may answer mystery of violent magnetic disturbances on earth.

Exact position of photograph in relation to the total sun surface is shown here. Plotting and photography of precise areas was made possible by airborne RCA television.

RCA REPORTS TO THE NATION:

REMARKABLE NEW PHOTOS UNLOCK MYSTERIES OF SUN'S SURFACE

Special RCA Television, operating from stratosphere, helps get sharpest photos of sun's surface ever taken

Scientists recently took the first, sharp, searching look into the center of our solar system. It was achieved not by a missile, but by a balloon posted in quiet reaches of the stratosphere.

The idea was conceived by astronomers at the Princeton University Observatory. They decided that a floating observatory—equipped with a telescope-camera—would offer a stable "work platform" from which sunspots could be photographed free of the distortion caused by the earth's atmosphere.

But "Project Stratoscope" encountered an unforeseen and major obstacle on its initial flight. A foolproof method was needed for aiming and focusing the telescope of the unmanned observatory. Princeton asked RCA to help.

A special RCA television system was devised which enabled observers on the ground to view exactly what the telescope was seeing aloft. This accomplished, it was a simple matter to achieve precise photography—directed from the ground by means of a separate RCA radio control system.

The resulting pictures reveal sunspot activities in unprecedented detail. They provide the world with important information regarding the magnetic disturbances which affect navigation and long-range communications.

The success of "Project Stratoscope" is another example of RCA leadership in advanced electronics. This leadership, achieved through quality and dependability in performance, has already made RCA Victor the most trusted name in television. Today, RCA Victor television sets are in far more homes than any other make.

RADIO CORPORATION OF AMERICA
THE MOST TRUSTED NAME IN ELECTRONICS

Answer to Monthly Quiz

At left is pictured part of FLAC II. Other parts of it can be found in boxes and crates in different rooms in Tompkins Hall. The computer was acquired from the Air Force last summer, and the administration hoped to have it operating this school year. Unfortunately, several obstacles stood: the Air Force hadn't signed over title to the University, and it would have been possible for them to remove it at any time; and the cost of installation was prohibitive. Both of the obstacles have been overcome. One by a grant of some $30,000 from the National Science Foundation for installation and maintenance costs, and the other by a contract with the Air Force. We hope that installation will soon be started, so the computer will be operable by next semester.

Engineering Advances

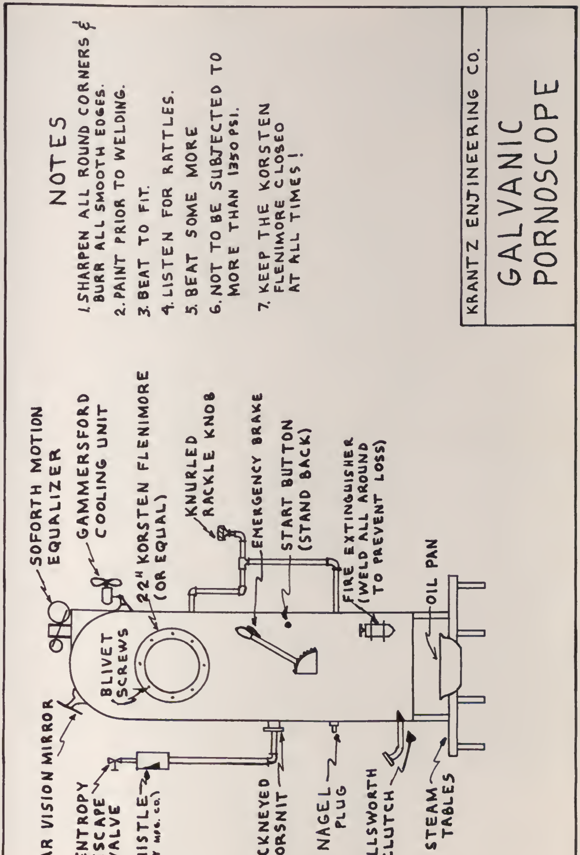
First of a Series

New and Useful Devices from the D-H Laboratories.

It has been brought to the attention of the MECHELECIV Board of Editors that the students here at George Washington are having their square little heads filled with too much theory and are completely ignorant of anything practical. This is a very serious problem, for how will our students earn the money needed to feed their poor starving mouths after that fateful June day arrives? To console these fears, we of the Board of Editors have taken it upon our bony shoulders to offer in this and the next two issues of MECHELECIV three very practical ideas, which we are sure would richly reward any engineer who brought them to his boss' attention.

This month's idea is directed to that eminent profession of pipe fitters known as "Mechanical Engineers." After much research on the subject and many long hours of consultation, the Board has come up with the Galvanic Pornoscope. We know all the M.E.'s at George Washington will immediately see many useful purposes to which the Galvanic Pornoscope may be put. No uses have yet been found, and we understand that a new course is being added to the M.E. curriculum next year for the sole purpose of examining this piece of machinery. We have not investigated the rumor fully, but we have it on good authority that one of the boxes in the basement of Tompkins Hall supposedly containing parts of FLAC II, really contains a Galvanic Pornoscope. Well, M.E.'s, we have given the ball to you; now take the Galvanic Pornoscope out and give it to posterity. Rah Rah Rah.

For your notebook . . .



MECH MISS . . .

Our March Mech Miss is the beautiful and talented Miss Elaine Bissell. Elaine is a junior studying at the Corcoran School of Art. Although she was born in North Carolina, Elaine has spent most of her life in this area. Her talents run to the more intellectual pursuits: reading, listening to classical music, and, of course, art.

After graduation, Elaine intends to go into commercial art because, as she puts it, "You have to eat, you know." Her great desire is to travel around the world, making paintings of the people she meets. She would like to start in Africa, of all places. Elaine, we wish you luck in all your endeavors.

Letters to The Editor

Comments and suggestions concerning Mecheleciv or any other phase of school activity are welcomed by the editor. Pertinent letters will be printed. Names will be withheld on request. However, names must be submitted with letters.

Dear Sirs,

The School of Engineering should feel embarrassed by the small number of students who attend the monthly engineering society meetings. At a recent meeting of the AIEE/IRE there were less than a dozen and a half people present, including society officers, faculty, and the speaker. Members of these organizations should attend the meetings regularly—not offer lame excuses as to why they could not make it. I have as many things to do as any student here and I could easily find dozens of reasons for not attending if I so desired. The fact is that students, especially in their junior and senior years. should have desire enough to meet and hear lectures from important men in the field in which they plan to dedicate their lives such that there should be standing room only.

I have heard it said that the business transacted at these meetings should be minimized to attract more attendance. This is being done. It would be hard to imagine a meeting with less business than the one to which I refer above. So this is not the reason for poor attendance. The real reason? Student laziness—the same sort of laziness that will lead to mediocre engineers.

One Who Was There.

Dear Sirs:

Your editorial in the December 1959 issue concerning exams not covering course material was very highly enjoyed and touches upon a great problem now present in the School of Engineering.

It would be extremely interesting to me to hear a defense of this existing exam method. However, it seems that only instructors endorse this system. Can you, therefore, obtain comments from any instructors on this subject?

FAILING.

Nosing its way down to earth, X-15's skin of a high-Nickel-containing alloy will glow with the dull cherry red of a tossed rivet.

ETV *(Continued from page 7)*

that eighty-nine colleges returned the questionnaires (an average of slightly more than two instructors per college responding), this gives a rather strong indication of the present reaction of college professors toward ETV. Also noteworthy at this point is that most of the instructors answering the questionnaire directed the largest part of their comments about the teacher at the studio teacher. One interpretation of this fact would be that the present college instructors, at least those who have had experience with educational television, feel that the presence of a receiving room teacher is not necessary, or that he need be, at most, only a proctor. At the college level, then, there quite apparently seems to be the general feeling that the television receiver set might very feasibly replace the classroom instructor in, at least, the lecture type courses. (The conceivability of this was shown earlier in the example of the mother with ten children, who graduated fulfilling her degree requirements entirely through television at home.) The comments in the fourth area were primarily concerned with the evaluation of student reaction toward educational television. One interesting aspect concerning students is the fact that one of the primary objections to educational television may actually be an advantage; the objection of the lack of contact between the student and the instructor. Many instructors feel that this separation will help the student increase both his ability to learn and his self-development. Supporting this belief is the fact that public libraries, in areas where ETV has been extensively used, have had an increase in the circulation of books corresponding to the courses being given over television. Suggestions requesting a method of helping a student learn via television were limited to only two, bearing out earlier findings which showed that there was no significant difference between the two methods of teaching. A conclusion to be drawn from the first four points is that the instructors responding feel that television might very probably be a better means of instructing than the conventional method; if the negative concern toward student learnability is considered as satisfaction with it. The remaining five areas elicited only twenty percent of the total comments, each receiving approximately equal portions of the comments left. The most prevalent of these comments were those suggesting analysis of costs for television versus conventional teaching, and for open-circuit television versus closed-circuit television.

This survey served to reaffirm what was already known, that educational television needed a significant amount of improvement, but it served one further purpose, it pointed out the direction of improvement most desired by the educators. After nineteen years of research and eight years of intense experimentation, ETV is finally taking root, but only in a limited fashion. As was stated earlier, most of the professors at Penn State University, a principle ETV experimental institution, are indifferent towards educational television. How, then, do the majority of the professors in the nation feel about it? How can ETV advance at a justifiable pace if those who are supposed to be its primary sources will not even look at it?

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ALLOYS *(Continued from page 9)*

While the expansion of the alloy is not great enough to cause a rupture, it insures a uniform pressure on the walls of the tubing. Under pressure, the distribution of stress in the system is the same as if the tubing were of solid, uniform material. The low melting temperature provides a safe, economical method of salvaging the filler after bending, and the low temperature of the filler-removal baths safe-guards workers against burns from the bath and the molten alloy.

Sir Isaac Newton was the first to compound a bismuth low-melting alloy, but the Cerro de Pasco Corporation developed the "cerro" alloys that simplified and improved several industrial techniques. Their uses have been many, ranging from tempering baths to dental models and from model hobbyists' parts to a radiopaque contrast medium in x-ray work. The primary reasons for the many uses of the alloys may be attributed to their low-melting temperatures and expansion properties. Thus, the engineer has available a group of alloys that can be used for a great many industrial processes, particularly experimental work. Except when used for fuses, the alloy can usually be salvaged and used again. Continual reuse of the alloys offers great savings to the user, and the low melting temperatures of the alloys protect handlers from serious burns.

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ATTEND

Engineers' Banquet and Ball

APRIL 23, 1960

Presidential Arms

$10.00 per couple — Ball only, $6.00

Dress optional

ATTENTION GRADUATING SENIORS

Don't forget next month's graduate record exam. No. exam, no graduation. Saturday April 9, 1960, 8:00-12:00 and 1:00-4:00. No paper and no slide rules, so you had better get hot and relearn those multiplication tables. Not that any of us will ever admit that we ever forgot them.

After the flood, Noah sent forth the animals with the admonition, "Each of you multiply, and one year hence meet here to show your accomplishments."

One year later, the animals assembled. All had multiplied except two little snakes. Noah, not the least discouraged, ordered trees to be cut and a table made of the logs. Then he said, "All go forth and multiply once again, and one year hence meet with me here."

When the animals met at the end of the year, all, including the snakes, had multiplied. Amazed, Noah's wife asked how he knew what to do to have the snakes multiply.

"Well," said Noah, "they were adders, and anyone knows that adders can't multiply without a log table."

* * *

There was a young lady named Gripe,
Whose speed was faster than light.
She set out one day,
In a relative way,
And returned home the previous night.

If all the deans at GWU held hands in a straight line, they would reach half-way across the Atlantic.

A lot of people are in favor of this scheme.

* * *

We heard that two Marjorie Webster girls went for a tramp in the woods, but he got away.

* * *

With a bottle or two of rare old wine
And a maiden with features and form divine,
On a night just made for love and laughter,
Who gives a damn for the morning after.

* * *

Familiarity breeds attempt.

* * *

A girl who swears she has never been kissed has a right to swear.

* * *

One goldfish to another: "O.K. wise guy. If there's no God, who changes the water?"

Pie-eyed Pete's young son came home crying from answering a want ad.

"Why wouldn't they give ye the job?" asked Pete.

"They said I was illiterate," sobbed the boy.

"They did, eh?" roared Pete. "They're damn liars. I kin prove I married your ma six months before you wuz born."

* * *

Many a happy home has been broken up by an idle roomer.

* * *

Little Boy Blue,
Go fetch your ma;
The hired girl's gone,
And we can't find pa.

* * *

In Paris, it's frankness;
In Panama, it's life;
In a professor, it's clever;
But in Mecheleciv it's uncouth.

THE LIVING END

Said the physicist mounting his bicycle,
"I've discovered the ultimate particle.
The thing is so small
That it's not there at all,
And can't be described in an article."

From IRE Student Quarterly

One of a series

Interview with General Electric's Earl G. Abbott, Manager—Sales Training

Technical Training Programs at General Electric

Q. Why does your company have training programs, Mr. Abbott?

A. Tomorrow's many positions of major responsibility will necessarily be filled by young men who have developed their potentials early in their careers. General Electric training programs simply help speed up this development process.

In addition, training programs provide graduates with the blocks of broad experience on which later success in a specialization can be built.

Furthermore, career opportunities and interests are brought into sharp focus after intensive working exposures to several fields. General Electric then gains the valuable contributions of men who have made early, well-considered decisions on career goals and who are confidently working toward those objectives.

Q. What kinds of technical training programs does your company conduct?

A. General Electric conducts a number of training programs. The G-E programs which attract the great majority of engineering graduates are Engineering and Science, Manufacturing, and Technical Marketing.

Q. How long does the Engineering and Science Program last?

A. That depends on which of several avenues you decide to take. Many graduates complete the training program during their first year with General Electric. Each Program member has three or four responsible work assignments at one or more of 61 different plant locations.

Some graduates elect to take the Advanced Engineering Program, supplementing their work assignments with challenging Company-conducted study courses which cover the application of engineering, science, and mathematics to industrial problems. If the Program member has an analytical bent coupled with a deep interest in mathematics and physics, he may continue through a second and third year of the Advanced Engineering Program.

Then there is the two-year Creative Engineering Program for those graduates who have completed their first-year assignments and who are interested in learning creative techniques for solving engineering problems.

Another avenue of training for the qualified graduate is the Honors Program, which enables a man to earn his Master's degree within three or four semesters at selected colleges and universities. The Company pays for his tuition and books, and his work schedule allows him to earn 75 percent of full salary while he is going to school. This program is similar to a research assistantship at a college or university.

Q. Just how will the Manufacturing Training Program help prepare me for a career in manufacturing?

A. The three-year Manufacturing Program consists of three orientation assignments and three development assignments in the areas of manufacturing engineering, quality control, materials management, plant engineering, and manufacturing operations. These assignments provide you with broad, fundamental manufacturing knowledge and with specialized knowledge in your particular field of interest.

The practical, on-the-job experience offered by this rotational program is supplemented by participation in a manufacturing studies curriculum covering all phases of manufacturing.

Q. What kind of training would I get on your Technical Marketing Program?

A. The one-year Technical Marketing Program is conducted for those graduates who want to use their engineering knowledge in dealing with customers. After completing orientation assignments in engineering, manufacturing, and marketing, the Program member may specialize in one of the four marketing areas: application engineering, headquarters marketing, sales engineering, or installation and service engineering.

In addition to on-the-job assignments, related courses of study help the Program member prepare for early assumption of major responsibility.

Q. How can I decide which training program I would like best, Mr. Abbott?

A. Well, selecting a training program is a decision which you alone can make. You made a similar decision when you selected your college major, and now you are focusing your interests only a little more sharply. The beauty of training programs is that they enable you to keep your career selection relatively broad until you have examined at first hand a number of specializations.

Furthermore, transfers from one General Electric training program to another are possible for the Program member whose interests clearly develop in one of the other fields.

Personalized Career Planning is General Electric's term for the selection, placement, and professional development of engineers and scientists. If you would like a Personalized Career Planning folder which describes in more detail the Company's training programs for technical graduates, write to Mr. Abbott at Section 959-13, General Electric Company, Schenectady 5, N. Y.

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